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DRAWINGS ATTACHED

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(54) APPARATUS FOR ELECTROSTATIC SPRAY COATING

(71) We, AIR-O-STATIC INC., 27 Locust Avenue, Wallington, New Jersey, 07057, United States of America; a corporation organized and existing under the laws of the State of New Jersey, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to improvements in electrostatic spray systems, and in particular to a novel and improved apparatus for spray coating articles wherein the deposition of the coating material is accomplished by means of electrostatic forces.

In the application of liquid materials, protective coatings, paints, finishing materials, fungicides, bacterial solutions, and the like, in the form of a spray to various articles, it is well-known to provide an electrostatic field between a charging electrode and the article to be coated, the electrostatic field serving to charge the spray particles and deposit them upon the article to be coated. Such a spray system has found widespread use particularly in the field of paint spraying, because of the efficiency of the electrostatic field in depositing the spray upon the object to be coated.

In the more recent developments of electrostatic spray deposition, an atomizer head is provided and is maintained at a very high electrical potential thereby serving as the charging electrode, while the article to be coated is maintained at ground potential, thereby creating a strong electrostatic field between the spray head and the work. If the applied voltage is sufficient, the field is effective to direct the liquid spray toward the grounded article to be coated and to deposit the spray on said article with very high efficiency.

While in some systems, the coating materials are atomized mechanically, as by means of a conventional air spray gun, and the atomized particles are propelled physically in the electrostatic field between an independent charging electrode or grid and the article to be coated, where the atomizer head itself is maintained at high potential to become the charging electrode of the field, the coating material thereon would atomize by means of electrostatic forces if the material was formed in a thin film having a sharp edge. Such electrostatic atomization is advantageous in that it avoids the necessity of providing means for mechanical atomization. In commercial use, the atomizer head is usually in the form of a disc or cup which is rotated by a motor to feed the coating material in the form of a fine film to its edge.

The provision of an atomizer head at high potential has its limitations and disadvantages. While deposition efficiency of the atomized spray increases with the increase of voltages employed, where electrostatic atomization is employed, it has been shown that there is a maximum potential gradient, above which the quality of atomization deteriorates. Thus deposition of the coating material suffers due to the requirements of electrostatic atomization. Further, where the atomizer head is maintained at a high potential and the articles to be coated are grounded, there is a tendency for arcing between the atomizer head and the articles, particularly where the head is brought close to the articles or where the articles are carried on a conveyor and swing toward the atomizer head. Since most coating compositions are combustible and some are highly inflammable, such arcing incurs a serious fire or explosion hazard. In addition, where the atomizer head is maintained at high potential, the coating material feed lines, pump and controls, as well as air and motor controls are also at high potential, presenting a serious shock hazard when they are approached by the operator.

It has been thought necessary to maintain a high potential gradient between the atomizer head and the article to be coated in order to obtain proper electrostatic deposition, even

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where the coating material was atomized by mechanical means. Thus, if both the atomizer head and article to be coated were maintained at the same potential in an electrostatic field, it would be expected that the atomized paint would, under the influence of the field, be directed away from the article to be coated rather than toward it. It has been found, however, that where both the article to be coated and the atomizer head are maintained at the same potential, preferably gound potential, and electrostatic field of suitable geometry is created surrounding these members, the field may be made effective to deposit the atomized coating material on the article with even greater efficiency than in the previous systems.

It is an object of the present invention, therefore to provide an electrostatic spray coating system wherein the coating material is centrifugally atomized from an atomizer head and wherein both the atomizer head and article to be coated are maintained at the same potential, preferably ground potential. In such an arrangement, there is no tendency for sparking or arcing between the atomizer head and the article to be coated, and the danger of shock to the operator in approaching or touching the atomizer head and its associated parts and controls is minimized.

Another object of the invention is the provision of an electrostatic spray coating system of the character described in which a rotary centrifugal atomizer head is employed together with a drive motor sufficient to rotate the head at extremely high velocities, thereby producing by centrifugal means atomized particles of a size smaller than that obtainable by electrostatic atomization. Since the centrifugal atomization is independent of the electrostatic forces of the surrounding field, there is no limit on the potential gradient of the field, and optimum deposition of the atomized spray may be obtained.

In accordance with the invention, there is provided an electrostatic spray coating system including an atomizer unit having a rotary head, means to feed coating material to said head and means for rotating said head to atomize the coating material centrifugally in the form of a fine spray flung radially from said head. One or more charging electrodes are located a short distance rearwardly of said head and spaced outwardly thereof, the charging electrodes being maintained at a high potential relative to an article to be coated which is spaced forwardly of said head and is preferably grounded. The atomizer head is also grounded and maintained at the same potential as the article to be coated. A strong electrostatic field is created between the charging electrode and the article to be coated outwardly of and surrounding the atomizer head in such a manner that when the atomized spray is propelled radially from the atomizer head, it enters this electrostatic field and is carried thereby to the article to be coated, being deposited on the latter. Means may be provided to supply a shroud of air under pressure around the atomized spray, the air shroud providing a forward component of movement to the spray, concentrating the same, and dampening its radial movement so that it is prevented from travelling radially through the field without coming under the influence thereof.

Additional objects and advantages of the invention will become apparent during the course of the following specification when taken in connection with the accompanying drawings, in which:

FIG. 1 is a side elevational view of a spray assembly made in accordance with the present invention and indicating the electrostatic fields which exist during the operation thereof, portions of the assembly being broken away or shown schematically for convenience of illustration;

FIG. 2 is a side elevational view of the atomizer unit and charging electrodes utilized in the assembly of FIG. 1, with portions thereof broken away;

FIG. 3 is a section taken along line 3—3 of FIG. 2;

FIG. 4 is a section taken along line 4—4 of FIG. 2;

FIG. 5 is an enlarged partial side elevational view, partially broken away and shown in section, of a modified form of charging electrode which may be employed in the spray assembly; and

FIG. 6 is an enlarged partial side elevational view, partially broken away and shown in section, of still another form of charging electrode.

Referring in detail to the drawings, and in particular to FIG. 1, there is shown a liquid spray coating system employing an atomizer unit 10 having a rotatable atomizer head 12, an article 14 to be coated, and charging electrodes 16 therefor. The atomizer unit 10 is mounted on a support arm 18 mounted on a stand, pedestal, or reciprocating apparatus (not shown).

The atomizer unit 10 contains an air motor which rotates the atomizer head 12 at high speed so that the liquid coating material fed thereto is atomized centrifugally. A pipe or conduit 20 connects the air motor to a source of air under pressure (not shown) such as a conventional air pump, for driving the motor. The source of air also supplies air under pressure to the interior of the atomizer unit 10 through pipe or conduit 22 for supplying a shroud of air around the spray of liquid coating material atomized by the head 12, in a manner to be presently described. The liquid coating material is supplied to the interior of atomizer unit 10 and thence to the atomizer head 12 through a pipe or conduit 24 connected to a liquid supply pump (not shown) of the usual type. In addition, a conductive cable

26 leading from one terminal of a high voltage power supply 28 leads within the atomizer unit 10 and is connected to the charging electrodes 16.

The atomizer unit 10 includes a rear base portion 30, a metallic impeller housing 32 and a metallic motor casing 34 interconnected to provide a completed assembly. Referring particularly to FIG. 3, it will be seen that the rear base portion 30 is solid and made of insulating material such as molded nylon. The impeller housing 32 is securely mounted on base portion 30 by means of a screw 36 extending within a threaded bushing 38 inset in said base portion 30. The impeller housing 32 is cylindrical, and the motor casing 34 is tubular and mounted on the forward end of said impeller housing in overlapping flush relationship therewith, as shown in FIG. 3, so as to form an air-tight seal therewith.

A metallic air motor 40 is mounted centrally within the motor casing 34, said motor comprising a main shaft 42 having a rear terminal portion 44 of reduced diameter upon which an impeller 46 is rigidly mounted, as by means of nut 47. The shaft 42 is rotatably mounted within motor casing 34 by a pair of ball bearing assemblies 48 and 50 at the opposite ends thereof, the annular inner races 52 of said ball bearing assemblies being secured to respective shoulders on the shaft 32. The outer ball bearing races 54 are secured to the inner surface of a motor shell 55, and are retained in position by a spacer tube 57.

The impeller 46 is located within the impeller housing 32 and is freely turnable therein. The impeller 46 has a series of V-shaped impeller blades formed therein and is secured to main shaft 42 by nut which is threaded on the rear portion 44 of said shaft and urges impeller 46 into frictional engagement with the inner race 52 of bearing 50 so that when the impeller is driven, the shaft 42 is rotated at high velocity.

The atomizer unit 10 has a motor air inlet coupling 60 which is threadedly mounted in the impeller housing 32 and communicates with a bore or port 62 which provides an air jet into the impeller chamber 64 within said impeller housing. The motor air supply pipe 20 is connected to the coupling 60 for supplying air under high pressure thereto.

The atomizer unit 10 has a nose portion 66 secured to the outer race 54 of ball bearing assembly 48 and to the forward end of motor casing 34, the nose portion closing off the front end of said motor casing. The shaft 68 of atomizer head 12 is journalled in a central opening in said nose portion and carries at its inner end a chuck 70 which is rigidly coupled to the main shaft 42 of motor 40.

The atomizer head 12 is made of conductive metal and is dish-shaped, having a forward interior surface 12a and a rear outer surface 12b. The head 12 has a large central opening 71, and a mounting disc 72 is spaced forwardly of said central opening and is concentric therewith. The disc 72 is rigidly mounted on the atomizer head 12 by means of a plurality of spaced accelerator rods 74. The mounting disc is secured to the front end of shaft 68, as by a screw and nut 73.

As shown in FIGS. 3 and 4, an annular disc 76 is rigidly mounted within the motor casing 34 just forwardly of the impeller housing 32, the rear end portion of the motor shell 55 extending through the central opening in said disc 76 and being supported thereby. The disc 76 has an annular row of spaced openings 78 therein.

The forward wall of the impeller housing 32 has an enlarged opening 80 communicating with the interior of the motor casing 34 through the disc openings 78. Thus, air introduced from motor air inlet coupling 60 to the impeller chamber 64, drives the impeller and then passes through the opening 80 and disc openings 78 to the interior of the motor casing 34 from whence it exits through small apertures 82 in the forward face of nose portion 66. This motor exhaust air impinges upon and is directed outwardly along the rear face of atomizer head 12 in general following the path indicated by the arrows A in FIG. 3.

The pipe 22 supplying auxiliary shroud air under pressure, is connected to a coupling 84 which extends through the motor casing 34 and communicates with the openings 78 in disc 76. This shroud air travels forwardly through the interior of motor casing 34, joining with the motor exhaust air, and escapes through the forward apertures 82, following the path of arrows A, to form an air shroud about the atomized spray, as will be presently described.

The liquid coating supply conduit 24 is connected to a coupling 86 which extends through the motor casing 34 and into disc 76, communicating with an enclosed opening 78a in said disc, that is to say an opening 78a which does not extend through the rear surface of disc 76 and is therefore closed off at its rear end. A pipe 88, extending through the interior of motor casing 34, connects the closed-off coating material supply opening 78a with a bore 90 in nose portion 66. The bore 90 in turn communicates with an annular passageway 91 formed in nose portion 66 and opening through the front surface thereof. A closed system for the coating material is thus provided, the material entering the interior of motor casing 34 through coupling 86, then flowing through pipe 88 directly to bore 90 and being distributed about passageway 91 in an annular pattern as it leaves the forward end of nose portion 66.

The forward central section of nose portion 66 extends into the central interior of atomizer head 12 and terminates in a circular flange 92 spaced slightly forwardly of the open end of annular passageway 91. The flange 92 is

normal to the axis of passageway 91 and acts as a baffle to direct the emerging coating material along the forward or inner surface of the atomizer head 12, the coating material following the path indicated by arrows *B* in FIG. 3.

The charging electrodes 16 each comprise a cylindrical rod of insulating material, each rod being L-shaped and having a radially-extending arm 96 and a substantially perpendicular, forwardly-extending arm 98. A wire 94 of copper or other highly conductive material is set within each charging electrode 16 and extends centrally and longitudinally through the arms 96 and 98, as shown in FIG. 3. Each arm 98 and its wire 94 terminates in a sharply pointed tip 100. As shown in FIGS. 2 and 3, each arm 98 forms with the respective arm 96 an angle slightly greater than 90° so that the tips 100 point slightly away from the atomizer unit 10. The arms 96 each terminate in an integral enlarged hollow tubular portion 102 of insulating material which extends radially into the rear base member 30, communicating with a circular recess 104 at the center thereof.

As shown in FIGS. 2 and 4, the high voltage cable 26 extends through a radially-disposed insulator sleeve 106 into the interior of rear base member 30, where it is electrically connected to the joined ends of the charging electrodes 16. This electrical connection is accomplished by a plurality of conductive metal balls 108 respectively secured to the wires 94 at the inner ends of the tubular portions 102 and to the end of cable 26, the balls being pressed together and making good electrical contact in the circular recess 104.

As was previously indicated, the atomizer head 12, the motor casing 34, impeller housing 32 and the constituent parts of motor 40 are all made of electrically conductive metal, as is the support arm 18 upon which the atomizer unit is mounted. The power supply 28 is a source of high voltage, one terminal of which is electrically connected to the charging electrodes 16 through cable 26, and the other terminal of which is connected to ground as indicated at G in FIG. 1. The other terminal of power supply 28 is also connected through ground to the support arm 18 and thus to the motor and atomizer head 12 which are therefore grounded as indicated at G_2 and G_3 in FIG. 1. The grounded terminal of the power supply 28 is also connected through ground to the article 14 to be coated as indicated by G_1 in FIG. 1. In practice, the grounding of article 14 would normally be accomplished through a grounded conveyor upon which article 14 is suspended by a hook or other means.

The power supply 28 is capable of supplying high voltages, for example, 100,000 volts or greater, depending upon the particular coating requirements, such as the spacing between the electrodes 16 and article 14, the size, shape and constituent material of the article 14, and the type of coating material employed. As is customary, the power supply 28 is adjustable to vary the supplied voltage over a wide range, as desired. When the power supply is energized, an electrostatic field is established between the pointed tips of the charged electrodes 16 and the grounded article 14 to be coated. This primary electrostatic field is indicated by the lines of force E shown in FIG. 1. Since a plurality of electrodes 16 are arranged around the periphery of the atomizer unit 10, the lines of force eminating from the individual electrodes complement each other to create a circular field completely surrounding the atomizer unit 10.

A portion of the field created extends between the charging electrodes 16 and the atomizer head 12 and metallic motor body. This portion may be designated as a secondary field and is indicated in FIG. 1 by the lines of force F.

Since the coating material is atomized centrifugally there is no limit on the maximum voltage which may be supplied, and the only consideration is the requirements of coating deposition.

The electrode tips 100 are arranged in a circle concentric with the rotary axis of atomizer head 12 and are located rearwardly of said atomizer head a sufficient distance so that the surrounding field defined by lines of force E is wide enough at the plane surrounding the atomizer head 12 to receive and act upon all of the atomized droplets propelled radially from said head. It will be understood that instead of employing individual spaced electrodes arranged circularly around the atomizer, the arms 96 and 98 may be made of insulating material and may support at their ends an external electrode grid in the form of a conductive wire of small diameter connected to the power supply 28. It will be appreciated that the electrode may, however, be made of any suitable material in any selected configuration and mounted adjacent the atomizer or on the atomizer by insulating means, according to the requirements of the coating operation.

In operation, air is fed under pressure through feed pipes 20 and 22 into the interior of the atomizer unit 10, the air fed through pipe 20 passing at high velocity through the impeller chamber 64, and by means of impeller 46, causing the air motor 40 to rotate the atomizer head 12 at high velocity. The air supply for the motor may be regulated to adjust the rotational speed of the atomizer head in a range up to 50,000 r.p.m.

Liquid coating material is then fed through pipe 24 into the interior of atomizer unit 10, the coating material flowing through pipe 88 and bore 90 into the space between the front surface of nose portion 66 and the disc 72. Since the disc is rotating at high speed with the atomizer head 12, the paint is ejected centrifugally onto the inner surface 12a of the

atomizer head 12 and flows in a thin film outwardly of the surface 12a until it reaches the edge 12c of atomizer head 12. Because of the high rotational speed of atomizer head 12, the liquid coating material is atomized in very fine droplets from the circular edge 12c, forming a fine spray of liquid which spreads radially from the atomizer head along the path indicated by the arrows C. If no electrostatic field were provided, this spray of atomized liquid would not have sufficient forward velocity to reach the article 14 to be coated.

When the power supply 28 is energized, a high potential is created between the charging electrodes 16 on the one hand, and the grounded article 14 to be coated and grounded atomizer head 12, on the other hand, creating the electrostatic field indicated by the lines of force E and F. In practice, the electrodes 16 are preferably negatively charged, while the atomizer head 12 and article 14 to be coated are positively charged. Since the atomizer head 12 and article 14 are both positively charged and are at the same potential and grounded, there is a zero average field therebetween. Thus, if the liquid coating material atomized by the head 12 were directed forwardly into the area indicated by the broken line H in FIG. 1, it would be under no field influence and would not, in this location, be deposited upon the article 14. However, the atomized coating material is ejected radially outward from the atomizer head 12 so that it enters the field defined by lines of force E and is deposited by such field upon the article 14 in the manner now to be described, unless air is applied to the shroud in sufficient force to itself direct the atomized coating material particles toward the articles to be coated.

Because the tips 100 of charging electrodes 16 are sharply pointed, they emit a corona discharge, that is a copious quantity of negative ions which disperse throughout the field and travel toward the grounded article 14 of opposite polarity. The centrifugally atomized particles of coating material leaving the grounded atomizer head 12 are positively charged through contact with said head. It would be expected that such positively-charged particles would be deposited on the pointed tips 100 of the charging electrode because of the field existing between said electrode tips and the atomizer head. Quite unexpectedly, however, such deposition does not occur. It is believed that the reason for this is that the large supply of negative ions emitted by the electrode tips 100 neutralize approaching positively-charged particles of coating material and then charge these particles negatively so that the particles are repelled by the electrodes 16 toward the grounded article 14.

In any event, the atomized particles of coating material are not directed rearwardly, but rather are physically propelled by centrifugal force in a radial direction so that they enter the primary field defined by lines of force E, as indicated by the stippled spray 110 in FIG. 1. The centrifugal and aerodynamic forces produced by the atomized head rotating at velocities in excess of 30,000 r.p.g. are sufficient to atomize the coating composition to average droplet sizes smaller than one mil, which is smaller than can be achieved by electrostatic atomization. Once the particles enter the field, they are bombarded by the negative ions emitted by the charging electrodes 16 and are negatively charged, being attracted to the article 14 and are deposited thereon. Thus, the atomized spray droplet or particles entering the surrounding field are attracted to the article 14 as the collecting electrode since article 14 has a considerably greater surface area than the pointed charging electrode tips 100. The particles follow the lines of force E and deposit on the article 14 with the desired and well-known "wrap-around" effect.

The force with which the atomized droplets are propelled from the centrifugal atomizer head 12 is sufficient to carry them through the secondary field defined by lines of force F so that they do not have an opportunity to come under the influence of the secondary field. On the other hand, the propelling force is not sufficient to physically drive the particles entirely through the primary field particularly since this force is dampened by the shroud of air provided. This air shroud is provided by the air fed through inlet pipe 22 as well as the motor exhaust air, which combines within the atomizer unit and exits through the circular row of small apertures in the front wall of nose portion 66. This stream of air under considerable pressure travels around the outer surface of the atomizer head 12, leaving the atomizer unit in the general direction of the arrows A in FIG. 3 and forms a cone-shaped shroud about the spray of atomized paint particles, concentrating the spray pattern as the pressure of air fed through pipe 22 is increased. The air shroud also serves to decelerate the atomized particles as they travel further away from the spray head, thus insuring that these particles will travel slowly enough within the primary field to enable the force of the field to deposit the particles on the article to be coated. In addition, the air shroud acts upon the particles within the primary field, supplying a forward thrust to complement the deposition action of the field itself. This is particularly useful where the head is located at short distances from the article to be coated especially where it is desired to fill cavities and corners of the article.

The advantages of utilizing a grounded atomizer unit including a grounded atomizer head will be readily apparent. Highly combustible coatings can be employed in the system shown herein without incurring the danger of explosion or fire due to arcing. Whereas in systems in which the atomizer head is connect-

ed to high voltage and the article to be coated is grounded, arcing will occur when the head is brought close to the article (as by the article swaying on its conveyor), such arcing cannot occur between the grounded head and grounded article of the instant system. In addition, the coating material supply pumps and/or pressure tanks are also grounded so that the system lends itself to the application of heated or refrigerated liquid coatings, as well as paints or coating materials normally applied at room temperature, without any of the shorting problems inherent in some of the previous systems. If intricately-shaped articles are to be coated, the atomizer head may be positioned close to the articles carried on a conveyor, in order to obtain optimum penetration into cavities and corners. The coating material supply controls, shroud air and motor air controls as well as the atomizer head itself may be freely handled by an operator without danger of shock.

FIG. 5 shows a modified form of charging electrode 120 in the form of a hollow tube 122 of insulating material. The electrode 120 is similar in size, shape and arrangement to the electrode 16 previously described. Within the insulating outer tube 122 is set an inner tube 124 of highly conductive metal terminating in a pointed tip 126 having a central through aperture 128. The metal tube 124 serves the same purpose as the wire 94 of the electrodes 16 and is connected to the source of high potential in the manner previously described. The hollow metal tube 124, however, also serves as a conduit for the shroud air and is fed by the shroud air supply pipe 22. For this purpose, the electrical cable connected to the power supply 28 is made in the form of a hollow tube 130 covered by an insulating sleeve 132. The air supply pipe 22 is connected to tube 130 so that air under pressure is fed therethrough to the interior of base member 30, where it is distributed to the electrode tubes 124. Thus air under pressure travels through the tube 124 of each charging electrode 120 and exits through aperture 128 which serves as a nozzle as well as the charging electrode tip. The air from all of the electrodes 120 combines to form a shroud around the spray of atomized particles eminating from the atomizer head.

FIG. 6 shows a further modification in the structure of the charging electrode. The hollow metal tube 134 is similar to the tube 124 and serves to supply shroud air therethrough, except that instead of terminating in a pointed tip, it has a flattened outer end 136 projecting outwardly of the insulating outer tube 122 and providing a narrow nozzle portion defining a relatively wide sharp edge 138. The sharp edge 138 serves efficiently as the charging zone for the electrostatic field, while the wide nozzle opening provides a larger fan of shroud air which covers a greater area.

Although the atomizer head 12 is illustrated as a cup or cone-shaped rotary dispersal head, said head can be constructed in a variety of configurations such as in the form of a flat disc, fan blade, etc. For most operations rotary atomizer heads ranging in size between 1 3/4" to 6" diameter are utilized. Larger diameter rotary heads can be employed for specific applications when required.

Although the apparatus described herein is primarily intended for automated type coating systems in which the articles to be coated are carried on a conveyor, its structure may also be adapted to portable hand gun systems used for coating stationary articles, small articles, and for touch-up operations.

WHAT WE CLAIM IS:—

1. An electrostatic spray coating assembly for atomizing coating material and depositing the latter upon the surface of an article, wherein said assembly comprises a rotary atomizer head having an atomizing surface for centrifugally atomizing liquid coating material and projecting the atomized coating material radially therefrom, and means for feeding coating material continuously to said atomizing surface of said head, characterized by electrode means located rearwardly of said atomizer head, means mounting said article forwardly of said atomizer head, a high voltage source having one terminal electrically connected to said electrode means and its opposite terminal connected to said article and to said atomizer head whereby the article and atomizer head are maintained at the same potential and an electrostatic field is established between the electrode means and article, said field surrounding and being spaced radially from said atomizer head for receiving therein atomized coating material projected radially from said atomizer head.

2. An electrostatic spray coating assembly according to Claim 1 which comprises a centrifugal atomizer unit including said rotary atomizer head, and in which said electrode means surrounds said atomizer unit rearwardly of said atomizer head for creating an electrostatic field between said electrode means and said article of sufficient strength to carry atomized coating material projected within said field to said article and deposit said coating material on the surface thereof, said atomizer unit including means for rotating said atomizer head at a high velocity sufficient to atomize coating material fed to said head into fine droplets and to project said atomized droplets radially from said atomizing surface with sufficient force to propel said droplets into the electrostatic field between said electrode means and said article.

3. An electrostatic spray coating assembly according to Claim 2 in which the terminal connected to said article and to said atomizer head is grounded, whereby said atomizer head is maintained at the same ground potential as said article.

4. An electrostatic spray coating assembly according to Claim 3 in which said atomizer unit has a plurality of air outlet apertures located rearwardly of said atomizer head and in which said assembly also includes means for feeding air under pressure to the interior of said atomizer unit, said air emerging through said outlet apertures and forming a shroud about the atomized coating material projected from said atomizer head, said air shroud dampening the velocity of said atomized material travelling radially through said field.

5. An electrostatic spray coating assembly according to Claim 4 in which said electrode means comprises a plurality of electrode elements mounted on said atomizer unit, insulated therefrom and spaced around the circumference thereof, each of said electrodes comprising a radially-extending leg terminating in a forwardly-directed leg, the latter terminating in a pointed tip, each of said tips being spaced radially outward from said atomizer head and being located rearwardly thereof.

6. An electrostatic spray coating assembly according to Claim 2 in which said centrifugal atomizer unit includes a hollow body mounting the rotary atomizer head at the forward end thereof, motor means mounted within said hollow body and having a drive connection to said atomizer head for rotating the latter, electrically insulating means mounting said electrode means on said atomizer body rearwardly of said head and surrounding the axis of rotation thereof, whereby said electrostatic field is spaced radially from said atomizer head and surrounds the axis of rotation thereof, and means for feeding compressed air through the interior of said atomizer body to emerge rearwardly of said atomizer head, such that said air forms a forwardly and radially-extending shroud extending from said head toward said article.

7. An electrostatic spray coating assembly according to Claim 6 in which said atomizer body has a front nose portion, rotatably mounting said atomizer head, and an annular row of air outlet openings located rearwardly of said head and arranged around the axis of rotation thereof.

8. An electrostatic spray coating assembly according to Claim 6 in which said electrode means comprises a plurality of electrode elements mounted on said atomizer unit and spaced around the circumference thereof, each of said electrodes comprising a radially-extending leg terminating in a forwardly-directed leg, the latter terminating in a pointed conductive tip, each of said tips being spaced radially outward from said atomizer head and being located rearwardly thereof pointing in the direction of said article, and means electrically insulating said electrode elements from said atomizer head.

9. An electrostatic spray coating assembly according to Claim 8 in which each of said electrode elements comprises an insulated member having a central conductive member extending axially therethrough from said tip to the interior of said atomizer body, and means for electrically connecting said conductive members to each other and to said one terminal of the high voltage source within said atomized body.

10. An electrostatic spray coating assembly according to Claim 9 in which each conductive member is hollow and its respective tip has an air outlet aperture therein in communication with said hollow conductive member, the opposite end of said hollow conductive member extending within said atomizer body and communicating with said air feeding means, whereby said shroud of air is generated from said electrode elements.

11. Apparatus for electrostatic spray coating as herein described with reference to the accompanying drawings.

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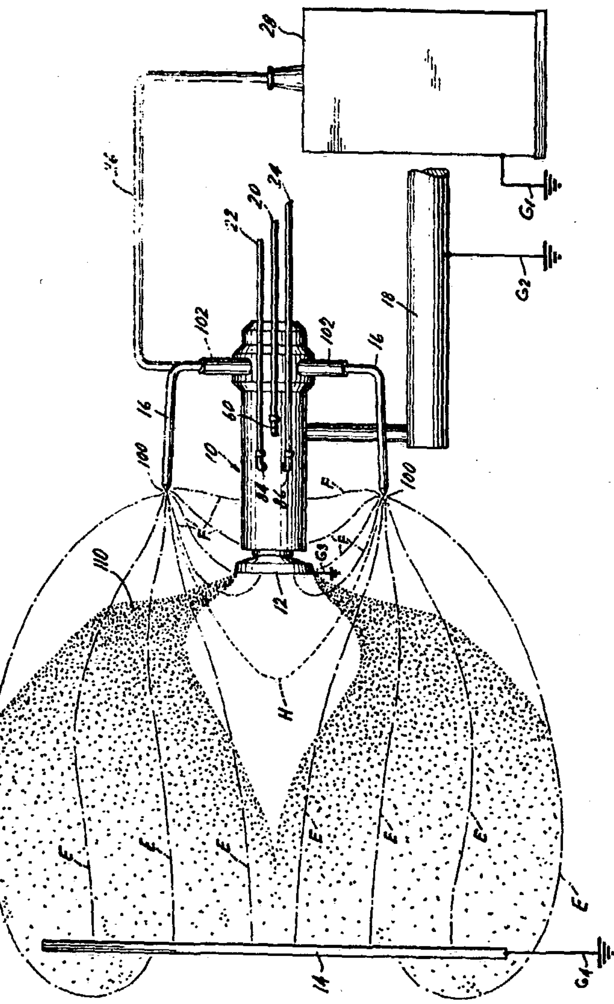
1209653 COMPLETE SPECIFICATION

3 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 1

FIG. 1.

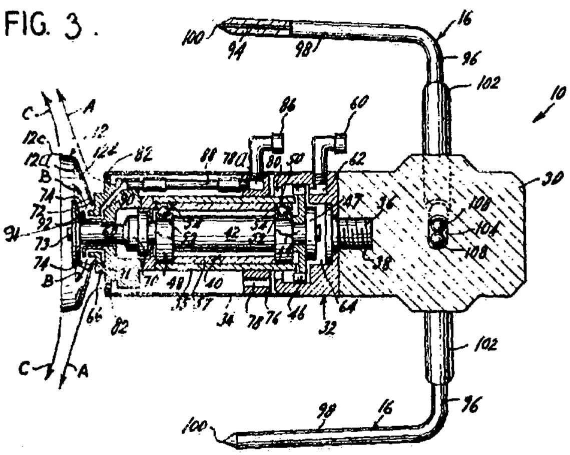


1209653 COMPLETE SPECIFICATION

3 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 2

FIG. 3.



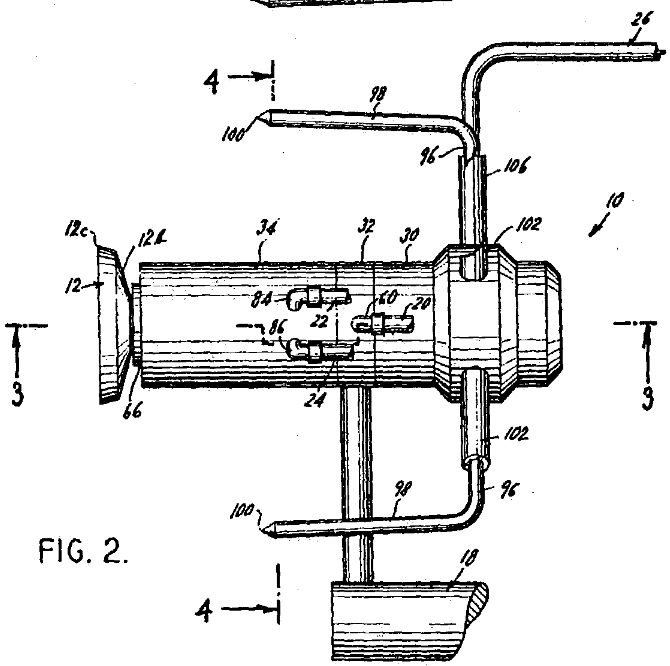


FIG. 2.

1209653 COMPLETE SPECIFICATION

3 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 3

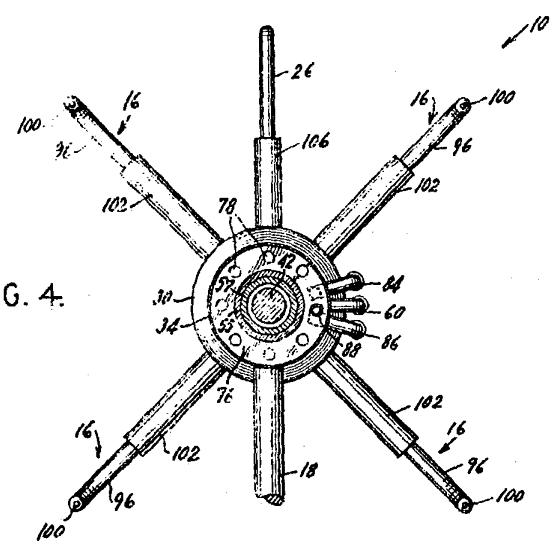


FIG. 4.

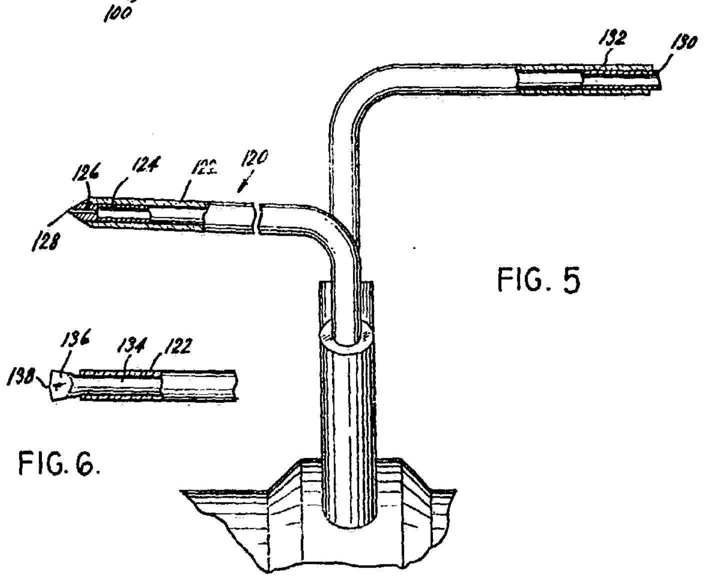


FIG. 5

FIG. 6.